Evaluation of Public Housing Authority Efficient Living Program

June 2013 through May 2014

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Executive Summary

This report presents the results of the impact and process evaluations for electric program year six and natural gas program year three (EPY6/GPY3) of the Public Housing Authority Efficient Living Program (Efficient Living Program) offered by the Illinois Department of Commerce and Economic Opportunity (DCEO). EPY6/GPY3 is defined as the period June 2013 through May 2014.

The main features of the approach used for the evaluation are as follows:

- An engineering desk review of program measures to verify gross savings estimates.
- Data for the study were collected through review of program materials and interviews with DCEO staff members.

The gross and net ex post kWh savings of the Efficient Living Program during the period June 2013 through May 2014 are summarized in Table ES-1. Because the Efficient Living Program targets low-income resident housing, the net ex post savings are assumed to equal the gross ex post savings. For EPY6/GPY3, net ex post electricity savings total 2,683,082 kWh for the period. For electricity savings, the program gross realization rate is 108%.

Gross and net ex post natural gas savings are shown in Table ES-2. Net ex post natural gas savings total 174,943 therms. The gross realization rate is 99%.

Table ES-1 Summary of kWh Savings for Efficient Living Program

Utility	*Ex Ante kWh Savings*	*TRM-Calculated*		*TRM-Calculated (Errata Corrected)*		*ADM-Calculated*			
		Gross Ex Post kWh Savings	*Net Ex Post kWh Savings*	*Gross Ex Post kWh Savings*	*Net Ex Post kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*
Ameren	790,628	761,890	761,890	761,916	761,916	817,818	103%	817,818	100%
ComEd	1,691,440	1,806,235	1,806,235	1,806,235	1,806,235	1,865,264	110%	1,865,264	100%
Total	2,482,068	2,568,125	2,568,125	2,568,150	2,568,150	2,683,082	108%	2,683,082	100%

Table ES-2 Summary of Therm Savings for Efficient Living Program

Utility	Ex Ante Therm Savings	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated			
		Gross Ex Post Therm Savings	Net Ex Post Therm Savings	Gross Ex Post Therm Savings	Net Ex Post Therm Savings	Gross Ex Post Therm Savings	Gross Realization Rate	Net Ex Post Therm Savings	Net-to-Gross Ratio
Ameren	33,181	17,630	17,630	17,845	17,845	31,195	94%	31,195	100%
Nicor	144,969	97,435	97,435	95,596	95,596	143,298	99%	143,298	100%
North Shore	1,123	1,276	1,276	1,276	1,276	1,276	114%	1,276	100%
Peoples	3,220	4,173	4,173	4,173	4,173	4,173	130%	4,173	100%
Total	182,493	120,514	120,514	118,890	118,890	179,943	99%	179,943	100%

The gross and net ex post peak kW reductions of the Efficient Living Program during the period June 2013 through May 2014 are summarized in Table ES-3. The gross and net ex post peak demand reductions total 567.48 kW for the period.

Table ES-3 Summary Peak kW Savings for Efficient Living Program

Utility	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated	
	Gross Ex Post kW Savings	Net Ex Post kW Savings	Gross Ex Post kW Savings	Net Ex Post kW Savings	Gross Ex Post kW Savings	Net Ex Post kW Savings
Ameren	187.87	187.87	187.87	187.87	242.20	242.20
ComEd	303.59	303.59	303.59	303.59	325.28	325.28
Total	491.47	491.47	491.47	491.47	567.48	567.48

The following presents a selection of key conclusions from EPY6/GPY3:

- **Changes in Program Realized Savings:** EPY6/GPY3 kWh savings declined from the prior year program savings by approximately 50%, while natural gas savings remained consistent. The change in savings reflects differences in the types of measures implemented as well as the quantity of measures implemented and changes in the specific measure characteristics. One of the challenges the program faces is that because they work with the same housing authorities each year, achieving savings becomes more difficult as the efficiency of public housing improves over time.
- **Program Staff Changes:** Staffing at the implementation partner, Building Research Council – School of Architecture, has remained consistent during the current program

year, EPY6/GPY3. However, DCEO lost two key staff members responsible for program oversight and administration. Overall, staffing resources appear to be adequate for effective program delivery. As DCEO staff brings new personnel up to date on the program operations and oversight functions communication and coordination between the Building Research Council – School of Architecture and DCEO should improve.

- **Program Outreach:** The Efficient Living Program staff conducted fourteen outreach events during EPY6/GPY3. Outreach events are designed to target the Illinois Public Housing Authority (PHA) community, contractors, and city officials that are interested in learning more about grant dollars available for energy efficiency investments. The events provided education about energy savings opportunities and information on how to apply and qualify for DCEO funds.
- **Program Design Changes:** Several changes were made to incentive offerings in EPY6/GPY3.
    - Rebates were made available for the replacement of mercury thermostats with programmable thermostats.
    - LED lighting upgrades were made available as a standard measure offering.
    - The custom incentive level increased from $2.00/therm to $3.00/therm for gas savings measures.
    - The overall incentive cap for projects in the ComEd service territory was increased from $350K to $450K.

  All program changes made in EPY6/GPY3 are in line with changes made to the Illinois Energy Now Programs Public Sector Programs.
- **New Program Website:** A new program website was developed to provide information to Illinois PHAs who have participated in the program in the past or are interested in participating in the future. The new website enables PHA staff to request an energy assessment by completing a digital form, submit a program application, and find out more about partner programs offerings. Visitors can download applications or directly access the program website for the HUD Rental Assistance Demonstration (RAD) Program, as well as DCEO's Affordable Housing Construction Program. Overall, the program website is well organized, and serves as a central location for the program forms. The website not only includes the required forms for program participation, but also other ancillary documentation, such as appliance recycling guidelines and certifications, income qualifications forms, and authorization forms to release utility billing data.
- **Program Successes:** Program successes include a smooth and streamlined delivery structure. The operational processes required to manage, deliver, and track the program activity are fluid and working well from an implementation perspective. The PHAs are

learning from experience and are more aware and proactive about identifying and implementing energy efficiency projects. During EPY6/GPY3 several PHAs partnered with Energy Service Companies (ESCO's) to fund large energy efficiency upgrades.

- **Program Challenges:** Program challenges include the loss of two key DCEO staff members who provided oversight and administrative support to the implementer. Some PHA staff has indicated that the prevailing wage requirement exceeds what contractors typically pay their crews in labor wages. Contractors have stated that if the wage requirements conformed to industry standards, grant dollars could be used to implement more energy savings measures. Additionally, the timing of program funds continues to present challenges to PHAs needing to complete project work by the end of the program year, which ends on May 31st. Finally, program staff indicated that additional funds can always be utilized, specifically in the Ameren Illinois territory, as well as additional dollars for gas measures could be utilized to replace outdated boilers.
- **Additional Program Changes for EPY7/GPY4:** Several changes are planned for EPY7/GPY4. There is discussion about extending the grant cycle beyond one year in order to allow for more flexibility on project completion time limits. Research indicates that the timing of the program year has limited the scope of past projects and continues to be a point of contention between PHAs and their contractors. Allowing projects to span multiple program years will improve the continuity of program delivery.

  Two new education and outreach strategies are being developed for EPY7/GPY4. The Efficient Living Program is looking to strengthen its partnership with the DCEO Trade Ally Program. Interviewed staff indicated that contractors could benefit from being better informed about working with the program and PHAs. Some contractors are not as familiar with the PHA procurement process, and others have little experience working with the non-profit sector and understanding the nuances of grant funding. Inviting these PHA contractors to join the DCEO Trade Ally Network is an approach that will be used to improve communication and educate contractors about DCEO programs and processes.

  To highlight the success of PHAs that are achieving at least 15% energy savings, the Efficient Living Program started a Plaque Program. Each PHA with projects that meet the minimum efficiency requirements will be presented with a certificate of success that is mounted on a plaque. In the long run it could be used as a branding strategy for the program and highlighted as an achievement in the PHA community.
- **Research in New Measure Types:** The program implementer, The Building Research Council – School of Architecture is researching breakthrough technologies such as appliance adapters, real-time energy dashboards and other technologies to provide feedback on energy consumption. A main focus of the research effort is to develop an energy use baseline to measure the impact of implementing these energy saving

measures. If potential exits with these grid technologies they could be included as future program offerings.

Overall, the program is operating effectively. The following recommendations are offered for consideration:

- **Develop Additional Protocols to Improve Accuracy of Savings Claims:** Due to the reuse of saving calculators, the program mistakenly included savings for measures implemented in the prior year.
- **Allocate Incentives for Duel Fuel Saving Measures across Natural Gas and Electric Grants:** It is recommended that staff allocate dollars from natural gas grants and electric grants to measures that result in electric and natural gas reductions (e.g., insulation in a residence with electric cooling and natural gas heating) to ensure that the associated savings for both fuel types are claimable.

1. Introduction

This report presents the results of the impact and process evaluations of the Illinois Department of Commerce and Economic Opportunity (DCEO) Public Housing Authority Efficient Living Program. This report presents results for activity during electric program year six and natural gas program year three (EPY6/GPY3), the period June 2013 through May 2014.

1.1 Description of Program

The Efficient Living Program was designed to help improve the energy efficiency of public housing in Illinois. Applicants requesting grant funds for electricity conservation measures must do so for sites serviced by DCEO.

The Efficient Living Program is operated in partnership with the School of Architecture-Building Research Council located at the University of Illinois at Urbana-Champaign (UIUC). The program provides grants to Illinois Public Housing Authorities to fund energy efficiency improvements for public housing buildings. The program includes retrofit, new construction, and gut / rehab projects. The program is available to applicants that manage public housing authorities located in Illinois.

Eligible energy efficiency measures can be installed in common areas or in residential units. A wide variety of measures are eligible for incentive funds including exit signs, exterior and interior lighting, controls, ENERGY STAR® appliances and HVAC equipment.

Grant awards include both standard and custom components described as follows:

- The standard component incentivizes the installation or use of energy efficient lighting equipment, HVAC equipment, water heaters, motors and variable frequency drives, appliances, insulation, and duct sealing.
- The custom component incentivizes qualifying energy measures at a rate of $0.20 per projected kWh or $3.00 per projected therms saved during the first program year of operation.

Grants are capped at $450,000 and cover up to, but do not exceed, 100% of the total project cost.

1.1.1 Expected kWh and Therm Savings

Expected kWh and therm savings for each utility are shown in Table 1-1 and Table 1-2. Twenty-eight housing authorities participated in the program during the period June 2013 through May 2014. The projects completed by these housing authorities were expected to provide annual savings of 2,482,068 kWh and 182,493 therms.

Table 1-1 Expected kWh Savings for Efficient Living Program by Utility

Utility	*Ex-Ante kWh Savings*
Ameren	790,628
ComEd	1,691,440
Total	2,482,068

Table 1-2 Expected Therm Savings for Efficient Living Program by Utility

Utility	*Ex Ante Therm Savings*
Ameren	33,181
Nicor	144,969
North Shore	1,123
Peoples	3,220
Total	182,493

1.2 Overview of Evaluation Approach

The overall objective for the impact evaluation of the Efficient Living Program was to determine the net electric savings, net natural gas savings, and peak demand (kW) reductions resulting from program projects implemented during EPY6/GPY3.

The impact evaluation approach included the following main features:

- Available documentation (e.g., invoices, savings calculation work papers, etc.) was reviewed for projects, with particular attention given to the calculation procedures and documentation for savings estimates.
- Gross savings were verified via analytical desk review.

The process evaluation approach involved the following:

- Review of program documentation and prior evaluation reports;
- Interviews with program staff members discussing program operations, successes, challenges, and future plans.

1.3 Organization of Report

The evaluation report for the Efficient Living Program is organized as follows:

- Chapter 2 presents and discusses the analytical methods and results of estimating program savings.
- Chapter 3 presents and discusses the analytical methods and results of the process evaluation of the program.

2. Impact Evaluation

This chapter presents the results of the impact evaluation of the Public Housing Authority Efficient Living Program offered by the Illinois Department of Commerce and Economic Opportunity (DCEO). The overall objective of the impact evaluation was to determine the net electricity and natural gas savings, as well as peak demand (kW) reductions resulting from program projects during the period June 2013 through May 2014. Section 2.1 describes the methodology used for estimating gross savings. Section 2.2 presents the results from the effort to estimate savings for a sample of projects.

2.1 Methodology for Calculating Program Savings

The methodology used for calculating program savings is described in this section. The overall objective for the impact evaluation of the Efficient Living Program was to determine the net electricity and natural gas savings, as well as peak demand (kW) reductions resulting from projects completed during EPY6/GPY3. When applicable, the measure-level algorithms from the Illinois Statewide Technical Reference Manual (TRM) Version 2.0 (Illinois TRM) were used to estimate savings (see Table 2-1).

Depending on the measure type, savings were calculated using up to three different approaches. These approaches were as follows:

- TRM-Calculated: Savings calculated as per Illinois's Statewide Technical Reference Manual Version 2.0.
- TRM-Calculated (Errata Corrected): Savings calculated per an erratum correction in Version 3.0 of the TRM.
- ADM-Calculated: Savings calculated using a non-TRM methodology. ADM-Calculated savings were performed when the measure was not in the TRM or when the methodology in the TRM was not applicable because the assumptions provided were not appropriate for this program.

Table 2-1 Illinois TRM Sections by Measure Type

Measure	*Section in Illinois TRM*	*Other Resources*	*TRM*	*Errata Corrected*	*ADM*
Air Conditioner	5.3.3	-	●		●
Air Conditioner Cover	N/A	Engineering review of ex ante calculations			●
Attic / Wall Insulation	5.6.4	-	●	●	
Boiler	5.3.6, 4.4.10	Engineering review of ex ante calculations	●	●	●
CFLs / LEDs / Lighting / Delamp	5.5.1, 5.5.6, 4.5.3, 4.5.2, 4.5.5	Engineering review of ex ante calculations	●		●
Clothes Washer	5.1.2	-	●		
Duct Insulation	5.3.4	-	●		
Indoor / Outdoor Reset Control	4.4.4	-	●	●	
Low-Flow Faucet Aerator	5.4.4	-	●		
Low-Flow Showerhead	5.4.5	-	●		
Natural Gas Furnace	4.4.11, 5.3.7	Engineering review of ex ante calculations	●	●	●
Occupancy Sensor	4.5.10	-	●		
Package Terminal Heat Pump	4.4.13	-	●		
Plug Load Occupancy Sensor	5.2.1	-	●		
Programmable Thermostats	5.3.11	-	●		
Refrigerator	5.1.6	-	●		
Refrigerator Recycling Savings	5.1.8	-	●		
Room Air Conditioner	5.1.7	-	●		
Room Air Conditioner Recycling Savings	5.1.9	-	●		
Vending Machine Controls	4.6.2	-	●		
Water Heater	5.4.2	-	●		

2.1.1.1. Air Conditioners

Ex post savings for air conditioners were developed using the following algorithm:

$$\Delta kWH = (FLHcool * BtuH * (1/SEERbase - 1/SEERee))/1000$$

Where,

FLHcool = Full load cooling hours

Btuh = Size of new equipment in Btuh

SEERbase = Seasonal energy efficiency ratio of baseline unit

SEERee = Seasonal energy efficiency ratio of efficient unit

2.1.1.2. Air Conditioner Cover

Air conditioner covers are not covered in the Illinois TRM. ADM reviewed the ex ante savings calculations and found them appropriate. Ex post savings for air conditioner covers were developed using the following algorithms:

$$\Delta Therms = Cf * Cd * \Delta U * Area\ in\ ft2 * HDD * (24\ hrs/day) * (1\ therm/100{,}000\ Btu) * (1/Heating\ COP)$$

Where,

$$\Delta U = 1/Rair - 1/Rcover$$

And,

$$\Delta kWh = Cf * Cd * \Delta U * Area\ in\ ft2 * HDD * (24\ hrs/day) * (1\ kWh/3{,}412\ Btu) * (1/Heating\ COP)$$

2.1.1.3. Attic / Wall Insulation

Ex post savings were calculated using the following savings algorithm:

$$\Delta kWh = (\Delta kWh\ Cooling + \Delta kWh\ Heating) * ADJ$$

Where,

$$\Delta kWh\ Cooling = (((1/R_{old} - 1/R_{wall}) * A_{wall} * (1 - Framing\ Factor) + (1/R_{old} - 1/R_{attic}) * A_{attic} * (1\text{-}Framing\_factor/2)) * 24 * CDD * DUA) / (1000 * \eta Cool)\ and$$

$$\Delta kWh\ Heating = ((1/R_{old} - 1/R_{wall}) * A_{wall} * (1 - Framing\ Factor) + (1/R_{old} - 1/R_{attic}) * A_{attic} * (1\text{-}Framing\ Factor/2)) * 24 * HDD) / (\eta Heat * 3412)$$

ADJ	=	Adjustment to account for prescriptive engineering algorithms
Rold	=	R-value of existing assembly and any existing insulation
Rwall	=	R-value of new wall assembly
Rattic	=	R-value of new attic assembly
Awall	=	Total area of insulated wall (ft2)
Aattic	=	Total area of insulated ceiling/attic (ft2)
Framing Factor	=	Adjustment to account for area of framing;
CDD	=	Cooling Degree Days;
DUA	=	Discretionary Use Adjustment;

ηCool	=	Seasonal Energy Efficiency Ratio of cooling system;
HDD	=	Cooling Degree Days;
ηHeat	=	Efficiency of heating system;

The Illinois TRM provides the following assumptions:

- The framing factor is 15%.
- The cooling degree days vary by climate zone but the average for Illinois is 947.
- The discretionary use adjustment is.75.
- Seasonal Energy Efficiency Ratio of cooling system is 10 for equipment older than 2006, otherwise 13.
- The heating degree days vary by climate zone but the average for Illinois is 4860.
- The efficiency of the heating system varies by system type and age of equipment.

Errata savings were calculated for attic and wall insulation. The algorithm presented in Version 2 of the Illinois Statewide TRM included an unspecified adjustment factor to account over claiming of savings. The Illinois Statewide TRM Version 3 updated the savings algorithm to specify this factor, which is applied to the calculation of heating savings.

2.1.1.4. Boiler

Ex post savings for commercial boilers installed in multifamily housing were developed using the following Illinois TRM algorithm:

$$\Delta Therms = EFLH * Capacity * (1/AFUE(base) - 1/AFUE(eff))/100{,}000$$

Where,

EFLH	=	Equivalent Full Load Hours for boiler heating
AFUE(base)	=	Estimate of baseline boiler annual fuel utilization efficiency rating.
AFUE(eff)	=	Efficient boiler annual fuel utilization rating.
Capacity	=	Nominal Heating Capacity Boiler size (Btuh)

The Illinois TRM provides the following assumptions:

- EFLH for a multifamily area installation is dependent on the zone. The average is 1,792.
- The AFUE(base) is 80%.

Errata savings were also calculated for this measure using the algorithm specified in Version 3 of the TRM. The corrected equation for these savings is:

*ΔTherms = EFLH * Capacity * ((EfficiencyRating(actual) – EfficiencyRating(base))/EfficiencyRating(base))/100,000*

Where,

EFLH	=	Equivalent Full Load Hours for boiler heating
EfficiencyRating(actual)	=	Efficiency Boiler Efficiency Rating use actual
EfficiencyRating(base)	=	Baseline Boiler Efficiency Rating
Capacity	=	Nominal Heating Input Capacity Boiler size (Btuh)

For single family serving units (or smaller units), ex post calculations used the following residential boiler savings algorithm:

*ΔTherms = Gas_Boiler_Load * (1/AFUE(base) - 1/AFUE(eff)).*

Where,

Gas boiler load	=	Estimate of annual household load for gas boiler.
AFUE(base)	=	Estimate of baseline boiler annual fuel utilization efficiency rating.
AFUE(eff)	=	Efficient boiler annual fuel utilization rating.

The Illinois TRM provides the following assumptions:

- The AFUE(base) is 80%.
- The gas boiler load is dependent on climate zone and averages 1,158 therms.

The AFUE rating for the efficient boiler was based on the specifications of the installed equipment.

2.1.1.5. CFLs / Lighting / Delamp

Ex post savings for lighting were developed using the following Illinois TRM algorithm:

*ΔkWh = ((WattsBase - WattsEE) / 1000) * ISR * Hours * WHFe*

Where,

WattsBase	=	Watts for baseline fixture.
WattsEE	=	Watts for energy efficient fixture.
ISR	=	In-service rate.
WHFe	=	Waste heat factor.

Hours = Annual hours of operation.

The Illinois TRM provides the following assumptions:

- The in-service rate for LEDs is 100%. For all other lighting it is 98%.
- The waste heat factor is 1.04.
- Hours of operation were dependent on space type.
- Baseline and efficient fixture watts were based on the fixture specifications.

Consistent with the TRM, the annual hours of operation provided by the participant were used in the savings calculations for T8 lighting. However, TRM deemed hours of operation for exit signs, LEDs, and CFLs. Illinois TRM specifies to use the following hours: 4,903 for exterior fixtures, 938 for residential fixtures, 5,950 for common area fixtures, and 8,766 for exit signs.

Ex post savings calculations for bi-level lighting were based on the Illinois Statewide TRM methodology.

2.1.1.6. Clothes Washer

Ex post savings were developed using the following Illinois TRM algorithms. For electricity savings,

$$\Delta kWh = [(Capacity * 1/MEFbase * Ncycles)*(\%CWbase + (\%DHWbase * \%Elect\_DHW) + (\%Dryerbase * \%Elect\_Dryer)] - [(Capacity * 1/MEFeff * Ncycles) * (\%CWeff + (\%DHWeff * \% Elect\_DHW) + (\%Dryereff * \%Elect\_Dryer)]$$

For natural gas savings,

$$\Delta Therm = [(Capacity * 1/MEFbase * Ncycles) * ((\%DHWbase * \%NG\_DHW * R\_eff) + (\%Dryerbase * \%Gas \_Dryer)] - [(Capacity * 1/MEFeff * Ncycles) * ((\%DHWeff * \%NG\_DHW * R\_eff) + (\%Dryereff * \%Gas\_Dryer)] * Therm\_convt$$

Where,

MEFbase = Modified Energy Factor of baseline unit

MEFeff = Modified Energy Factor of efficient unit

Ncycles = Number of cycles per year

Capacity = Clothes Washer capacity of the new unit

%CW = Percentage of energy consumption for Clothes Washer

%DHW = Percentage of energy consumption for water heating

%Dryer = Percentage of energy consumption for dryer operation

%Elect_DHW	=	Percentage of DHW savings assume to be electric
%Elect_Dryer	=	Percentage of dryer savings assume to be electric
%NG_DHW	=	Percentage of DHW savings assume to be Natural Gas
%Gas_Dryer	=	Percentage of dryer savings assume to be Natural Gas
R_eff	=	Recovery efficiency factor
Therm_convt	=	Conversion factor from kWh to Therms

Savings calculations utilized the following Illinois TRM specified inputs:

- The Modified Energy Factor for baseline equipment was 1.64.
- The number of annual wash cycles was 295 for residential units and 950 for commercial units.
- Baseline clothes washer energy usage was 7%.
- Baseline water heater usage for clothes washers was 33%.
- Baseline dryer usage for clothes washers was 59%.
- The recovery energy factor was 1.26.
- The conversion factor from kWh to therms was 0.03413

The equation inputs for the percentage of total energy consumption for clothes washer operation, percentage of total energy consumption used for water heating, and the percentage of total energy consumption for dryer operation were determined based on an Illinois TRM table, which differentiates inputs by the efficiency of the newly installed clothes washer. Tier 3 efficient clothes washers were most often installed through the program, for which the Illinois TRM specifies the percentage of energy consumption for the clothes washer, water heating, and the dryers as 10%, 16%, and 74%, respectively.

2.1.1.1. Duct Insulation

Ex post savings for duct insulation were developed using Methodology 2: Evaluation of Distribution Efficiency from the Illinois Statewide TRM. This methodology specifies the following algorithm for savings:

$$\Delta kWh_{cooling} = (((DEafter - DEbefore)/DEafter)*FLHcool*Capacity)/1000/nCool$$

Where,

DEafter	=	Distribution Efficiency after duct sealing
DEbefore	=	Distribution Efficiency before duct sealing

FLHcool	=	Full load cooling hours
Capacity	=	Capacity of Air Cooling system
nCool	=	Efficiency (SEER) of Air Conditioning equipment

Savings calculations utilized the following Illinois TRM specified inputs:

- The average FLHcool for duct sealing is 564 for multifamily and 629 for single family
- Capacity, nCool, DEbefore, and DEafter are dependent on site specific information

2.1.1.2. Indoor / Outdoor Reset Control

Ex post savings for indoor / outdoor reset controls were developed using the following algorithm:

*ΔTherms = Binput * SF * EFLH / (Effpre *100)*

Where,

Binput	=	Boiler Input Capacity (kBTU)
SF	=	Savings Factor = .08
EFLH	=	Equivalent Full Load Hours for heating (based on zone)
Effpre	=	Boiler efficiency

For this measure, errata savings were calculated using the algorithm in Version 3 of the TRM. The difference between Version 3 and Version 2 of the TRM is that Eff_{pre} factor is removed from the Version 3 algorithm.

2.1.1.3. Low-Flow Faucet Aerator

Ex post savings were developed using the following algorithms:

For units with electric domestic hot water,

*ΔkWh = %ElectricDHW * ((GPM_base * L_base - GPM_low * L_low) * Household * 365.25 *DF / FPH) * EPG_electric * ISR*

For units with natural gas domestic hot water,

*ΔTherms = %FossilDHW * ((GPM_base * L_base - GPM_low * L_low) * Household * 365.25 *DF / FPH) * EPG_gas * ISR*

Where,

%ElectricDHW	=	The proportion of water heating supplied by electricity.

%FossilDHW	=	The proportion of water heating supplied by natural gas
GPM_base	=	Average flow rate, in gallons per minute, of baseline faucet.
L_base	=	Average baseline length faucet use per capita for all faucets in minutes.
GPM_low	=	Average flow rate, in gallons per minute, of the low-flow faucet aerator.
L_low	=	Average length of retrofit faucet use per capita for all faucets in minutes.
Household	=	Average number of people per household.
DF	=	The drain factor.
FPH	=	Faucets per household.
EPG_electric	=	The energy per gallon of water used by faucet supplied by electric water heater.
EPG_gas	=	The energy per gallon of water used by faucet supplied by natural gas water heater.
ISR	=	The in-service rate.

Ex post calculations were based on the following values provided in the TRM:

- The average flow rate of the baseline faucet is 2.25 for bathrooms and 2.75 for kitchen aerators. Unknown area installation GPM is 1.2.
- The average flow rate of the low-flow faucet is 1.5 for bathrooms and 2.2 for kitchen aerators. Unknown area installation GPM is .94.
- The average lengths of faucet use per capita for the baseline and low-flow faucet in minutes per person per day are 2.95 for bathrooms, 6.9 for kitchens, and 9.85 for unknown installation areas.
- The average number of people per household is 2.56 for single-family and 2.1 for multi-family.
- The drain factor is 75% for kitchen, 90% for bath, and 79.5% if the location is unknown.
- The faucets per household for 3.83 for single-family and 2.5 for multi-family.
- The energy per gallon of water used by a faucet supplied by electric water heater is .0894 kWh per gallon.

- The energy per gallon of water used by a faucet supplied by natural gas water heater is .003999 therms per gallon for single family and .00446 therms per gallon for multi-family homes.
- The in-service rate is .95 for single family and .91 for multi-family kitchens and .95 for multi-family bathrooms.

2.1.1.4. Low-Flow Showerhead

Ex post savings were developed using the following algorithms:

For electricity savings,

*ΔkWh = %ElectricDHW * ((GPM_base * L_base - GPM_low * L_low) * Household * SPCD * 365.25 / SPH) * EPG_electric * ISR*

For natural gas savings,

*ΔTherms = %FossilDHW * ((GPM_base * L_base - GPM_low * L_low) * Household * SPCD * 365.25 / SPH) * EPG_gas * ISR*

Where,

%ElectricDHW	=	Proportion of water heating supplied by electricity.
%FossilDHW	=	Proportion of water heating supplied by natural gas.
GPM_base	=	Flow rate of the baseline showerhead.
L_base	=	Length of shower in minutes with baseline showerhead.
GPM_low	=	Flow rate of the low-flow showerhead.
L_low	=	Length of shower in minutes with low-flow showerhead.
Household	=	Average number of people per household.
SPCD	=	Showers per capita per day.
SPH	=	Showers per household.
EPG_electric	=	Energy per gallon of hot water supplied by electric.
EPG_gas	=	Energy per gallon of hot water supplied by natural gas.
ISR	=	The in-service rate.

The following assumptions were used in ex post calculations:

- The in-service rate is 98% for single family locations and 93% for multifamily.
- The number of showers per capita per day is .75
- The length of shower in minutes for the baseline and low-flow showerhead is 8.2.
- The gallons per minute for the baseline showerhead are 2.67.
- The gallons per minute of low-flow shower head are 1.5.
- The showers per household are dependent on the customer provided information.
- The average number of people per household is based on information provided by participants.

2.1.1.5. Natural Gas Furnace

Ex post savings were developed using the following TRM algorithm:

$$\Delta Therms = Furnace\ capacity\ (in\ Btuh) * (1/AFUE(base) - 1/AFUE(eff)) * (FLHw/100{,}000)$$

Savings calculations utilized the following inputs:

- Full load hours (FLHw) are from the commercial furnace section of the Illinois Statewide TRM;
- Annual fuel utilization efficiency (AFUE) for baseline equipment is. 80;
- Furnace capacity is based on installed unit capacity.

Errata savings were calculated for this measure due to a correction in the Illinois Statewide TRM Version 3. The savings algorithm for errata savings is:

$$\Delta Therms = EFLH * Capacity *((AFUE(eff) – AFUE(base))/AFUE(base))/ 100{,}000$$

Where,

EFLH	=	Equivalent Full Load Hours.
Capacity	=	Nominal Heating Input Capacity Furnace Size
AFUE(eff)	=	Efficient Furnace Annual Fuel Utilization Efficiency Rating
AFUE(base)	=	Baseline Furnace Annual Fuel Utilization Efficiency Rating

Ex post kWh savings for furnace motors were based on the Illinois TRM deemed values. Total kWh savings include deemed savings of 469 kWh for the furnace motor and 263 kWh for the air conditioner, if present.

2.1.1.6. Occupancy Sensor

Ex post savings were developed using the following algorithm:

$$\Delta kWh = KWcontrolled * Hours * ESF * WHFe$$

Where,

kW controlled	=	The total lighting load connected to the controlled lights.
Hours	=	The total operating hours of the controlled lighting circuit before the lighting controls are installed.
ESF	=	Energy savings factor representing the percentage reduction to the operation hours from the non-controlled baseline lighting system.
WHFe	=	Waste heat factor.

The Illinois TRM provides the following assumptions:

- The energy savings factor is 41% for wall or ceiling mounted sensors.
- The waste heat factor is 1.34.

Site specific specifications were used for the kW controlled and operating hours.

2.1.1.7. Package Terminal Heat Pumps

Ex post savings for package terminal heat pumps were developed using the following algorithms:

$$\Delta kWh = Annual\ kWh\ Savings cool + Annual\ kWh\ Savings heat$$

With,

$$Annual\ kWh\ Savings cool = (kBtu/hcool) * [(1/EERbase) - (1/EERee)] * EFLHcool$$

$$Annual\ kWh\ Savings heat = (kBtu/hheat)/3.412 * [(1/COPbase) - (1/COPee)] * EFLHheat$$

Where,

kBtu/hcool	=	Capacity of the cooling equipment in kBtu per hour.
EFLHcool	=	Cooling mode equivalent full load hours.
EFLHheat	=	Heating mode equivalent full load hours.
EERbase	=	Energy Efficiency Ratio of the baseline equipment.
EERee	=	Energy Efficiency Ratio of the energy efficient equipment.

COPbase = Coefficient of performance of the baseline equipment.

COPee = Coefficient of performance of the energy efficient equipment.

2.1.1.8. Plug Load Occupancy Sensor

Ex post savings were developed using a deemed value of 103 for a seven plug smart strip from the Illinois Statewide TRM.

2.1.1.9. Programmable Thermostats

Ex post savings were developed for programmable thermostats using the following algorithms:

$$\Delta kWh = \%ElectricHeat * Elec\_Heating\_Consumption * Heating\_Reduction * HF * Eff\_ISR + (\Delta Therms * Fe * 29.3)$$

With,

$$\Delta Therms = \%FossilHeat * Gas\_Heating\_Consumption * Heating\_Reduction * HF * Eff\_ISR$$

Where,

%ElectricHeat = Percentage of heating savings assumed to be electric.

%FossilHeat = Percentage of heating savings assumed to be gas.

Gas_Heating_Consumption = Estimate of annual household heating consumption for gas heated homes.

%Elec_Heating_Consumption = Estimate of annual household heating consumption for electrically heated homes.

Heating_Reduction = Assumed percentage reduction in heating energy consumption

HF = Household factor to adjust heating consumption

Eff_ISR = Effective in-service rate

2.1.1.10. Refrigerators

Ex post savings were developed using the Illinois Statewide TRM. Under this methodology,

$$\Delta kWh = UEC_{BASE} - UEC_{EE}$$

Where,

UEC_{BASE} = Annual Unit Energy Consumption of baseline unit, and

UEC_{EE} = Annual Unit Energy Consumption of ENERGY STAR unit

Unit energy consumption can be determined by using the algorithms specified in the following table:

Table 2-2 Unit Energy Consumption of Refrigerators

Product Category	NAECA as of July 1, 2001 Maximum Energy Usage in kWh/year	Current ENERGY STAR level Maximum Energy Usage in kWh/year
1. Refrigerators and Refrigerator-freezers with manual defrost	8.82*AV+248.4	7.056*AV+198.72
2. Refrigerator-Freezer--partial automatic defrost	8.82*AV+248.4	7.056*AV+198.72
3. Refrigerator-Freezers--automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerators--automatic defrost	9.80*AV+276	7.84*AV+220.8
4. Refrigerator-Freezers--automatic defrost with side-mounted freezer without through-the-door ice service	4.91*AV+507.5	3.928*AV+406
5. Refrigerator-Freezers--automatic defrost with bottom-mounted freezer without through-the-door ice service	4.60*AV+459	3.68*AV+367.2
6. Refrigerator-Freezers--automatic defrost with top-mounted freezer with through-the-door ice service	10.20*AV+356	8.16*AV+284.8
7. Refrigerator-Freezers--automatic defrost with side-mounted freezer with through-the-door ice service	10.10*AV+406	8.08*AV+324.8

Where,

*AV = Adjusted_volume = Fresh_volume + (1.63 * Freezer_volume)*

2.1.1.11. Refrigerator Recycling Savings

Ex post savings for refrigerator recycling were based on the following Illinois TRM algorithm.

*ΔkWh = [116.84 + (Age * 10.90) + (Pre-1990 * 431.79) + (Size * 19.42) + (Single-Door * -795.37) + (Side-by-side * 426.41) + (Proportion of Primary Appliances * 170.98) + (CDD/365.25 * unconditioned * 17.34) + (HDD/365.25 *unconditioned *-11.78)] * Part Use Factor*

2.1.1.12. Room Air Conditioner

Ex post savings were developed using the following Illinois TRM algorithm:

$$\Delta kWh = (Btuh/1{,}000) * (1/EERexisting - 1/EERnew) * FLH_s$$

Where,

FLH_s	=	Full load cooling hours
EERexisting	=	Energy efficiency ratio of baseline equipment
EERnew	=	Energy efficiency ratio of efficient equipment.
Btuh	=	Unit capacity

2.1.1.13. Room Air Conditioner Recycling Savings

Ex post savings were developed for the recycling of old inefficient refrigerators, packaged terminal heat pumps, and room air conditioners.

For room air conditioners, ex post savings calculations were based on the following algorithm:

*ΔkWh = FLH_RAC * BtuH*(1/EERexist)) /1000*

Where,

FLH_RAC	=	Full Load Cooling Hours of room air conditioning unit
BtuH	=	Size of retired unit
EERexist	=	Efficiency of existing unit = 7.7

2.1.1.14. Vending Machine Controls

Ex post savings were developed using the following Illinois TRM algorithm:

*ΔkWh = WATTSbase / 1000 * HOURS * ESF*

Where,

WATTSbase	=	The connected watts of the vending equipment.
HOURS	=	The operating hours of the connected equipment.
ESF	=	An energy savings factor that represents the percent reduction in annual kWh of the controlled equipment.

The Illinois TRM provides the following assumptions:

- The baseline watts for refrigerated beverage vending machines are 400 and 85 for non-refrigerated snack vending machines.
- The hours are 8766.

- The energy savings factor for refrigerated beverage vending machines and non-refrigerated snack vending machines is 46%.

2.1.1.15. Water Heater

Ex post therm savings for Natural Gas Water Heaters were calculated using the following algorithm:

$$\Delta Therms = (1/EFbase - 1/EFefficient) * (GPD * 365.25 * \gamma Water * (Tout - Tin) * 1.0) /100,000$$

The Illinois TRM provides the following assumptions:

- The efficiency of baseline equipment is dependent on tank size.
- The efficiency for energy efficient unit is dependent on unit type.
- The tank temperature is 125 °F.
- The incoming water temperature is 54 °F.
- The specific weight of water is 8.33 lb.
- The gallons of water used per day are 50.

2.2 Results of Impact Evaluation

This section presents the results of the impact evaluation for the Efficient Living Program during the period of June 2013 through May 2014.

2.2.1 Program-Level Savings Results

This subsection presents the gross and net savings for the Efficient Living Program. A net-to-gross factor of 100% was used because the Efficient Living Program targets low income residents. The gross and net ex post electricity savings of the Efficient Living Program during the period June 2013 through May 2014 are summarized by utility in Table 2-3. Net ex post electricity savings total 2,683,082 kWh for the period.

Table 2-3 Summary of kWh Savings for Efficient Living Program by Utility

Utility	Ex Ante kWh Savings	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated			
		Gross Ex Post kWh Savings	Net Ex Post kWh Savings	Gross Ex Post kWh Savings	Net Ex Post kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	Net Ex Post kWh Savings	Net-to-Gross Ratio
Ameren	790,628	761,890	761,890	761,916	761,916	817,818	103%	817,818	100%
ComEd	1,691,440	1,806,235	1,806,235	1,806,235	1,806,235	1,865,264	110%	1,865,264	100%
Total	2,482,068	2,568,125	2,568,125	2,568,150	2,568,150	2,683,082	108%	2,683,082	100%

The gross and net ex post peak kW reductions of the Efficient Living Program during the period June 2013 through May 2014 are summarized in Table 2-4. The achieved net peak demand savings total 567.48 kW.

Table 2-4 Summary of Peak kW Savings for Efficient Living Program by Utility

Utility	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated	
	Gross Ex Post kW Savings	Net Ex Post kW Savings	Gross Ex Post kW Savings	Net Ex Post kW Savings	Gross Ex Post kW Savings	Net Ex Post kW Savings
Ameren	187.87	187.87	187.87	187.87	242.20	242.20
ComEd	303.59	303.59	303.59	303.59	325.28	325.28
Total	491.47	491.47	491.47	491.47	567.48	567.48

Measure level savings and realization rates are presented in Table 2-5. Explanations for differences between ex ante and ex post savings are provided for measures with realization rates not equal to 100%.

Table 2-5 Summary of kWh Savings for Efficient Living Program by Measure Type

Measure	Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	Source of Discrepancy
A/C cover (electric heating)	15,630	15,630	100%	
Attic/Ceiling Insulation Sf	86	96	112%	Heating kWh savings affected by therm savings calculation inclusion of an extra ADJ factor
Bi-Level Stairwell Fixtures	31,016	31,013	100%	
CFL Delamping	440	1,025	233%	Customer hours used for CFL common and exterior areas.
CFLs	670,134	730,580	109%	Customer hours used for CFL common and exterior areas.
ENERGY STAR®	37,388	37,389	100%	

Measure	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Source of Discrepancy*
Refrigerators				
High Efficiency Air Conditioner	16,618	16,618	100%	
High Efficiency Furnace & A/C Combos	206,153	207,930	101%	Residential methodology used for one commercial AC unit
High Efficiency Furnaces	58,780	58,780	100%	
High Efficiency Washing Machines	3,445	3,480	101%	One site was reporting savings for one unit instead of two
High Efficiency Window A/C Units	58	58	100%	
LED Exit Signs	42,921	45,756	107%	Waste heat calculation not in LED Exit Sign TRM section
LEDs	244,732	379,188	155%	Customer hours used for LED common and exterior areas.
Low-Flow Shower Heads	33,586	33,586	100%	
Occupancy Sensors	29,224	29,226	100%	
Package Terminal Heat Pump	22,298	22,298	100%	
Plug Load Occupancy Sensors	515	515	100%	
Programmable Thermostats	7,807	7,807	100%	
Recycling (Refrigerators and Room ACs)	436,028	434,410	100%	
T8 Delamping	67,051	67,181	100%	
T8s	549,750	552,108	100%	
Vending Machine Controls	8,408	8,407	100%	
Total	2,482,068	2,683,082	108%	

The gross and net ex post therm savings of the Efficient Living Program during the period June 2013 through May 2014 are summarized by utility in Table 2-6. Net ex post natural gas savings total 179,943 therms for the period.

Table 2-6 Summary of Therm Savings for Efficient Living Program by Utility

Utility	Ex Ante Therm Savings	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated			
		Gross Ex Post Therm Savings	Net Ex Post Therm Savings	Gross Ex Post Therm Savings	Net Ex Post Therm Savings	Gross Ex Post Therm Savings	Gross Realization Rate	Net Ex Post Therm Savings	Net-to-Gross Ratio
Ameren	33,181	17,630	17,630	17,845	17,845	31,195	94%	31,195	100%
Nicor	144,969	97,435	97,435	95,596	95,596	143,298	99%	143,298	100%
North Shore	1,123	1,276	1,276	1,276	1,276	1,276	114%	1,276	100%
Peoples	3,220	4,173	4,173	4,173	4,173	4,173	130%	4,173	100%
Total	182,493	120,514	120,514	118,890	118,890	179,943	99%	179,943	100%

**A net-to-gross ratio of 100% is applied because the Efficient Living Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.*

Measure level savings and realization rates are presented in Table 2-7. Explanations for differences between ex ante and ex post savings are provided for measures with realization rates not equal to 100%.

Table 2-7 Summary of Therm Savings for Efficient Living Program by Measure Type

Measure	Ex Ante Therm Savings	Gross Ex Post Therm Savings	Gross Realization Rate	Source of Discrepancy
Attic/Ceiling Insulation Sf	1,384	1,870	135%	Ex ante calculations applied ADJ factor twice
A/C cover (gas heating)	660	660	100%	
Duct Sealing & Insulation	261	261	100%	
High Efficiency Boilers	65,068	65,068	100%	
High Efficiency Furnace & A/C Combos	14,941	13,943	93%	Negative therm savings for blower motor was not included in ex ante calculations
High Efficiency Furnaces	43,996	41,658	95%	Negative therm savings for blower motor was not included in ex ante calculations
High Efficiency Water Heaters	6,047	7,339	121%	Used a different value for gallons per day than the TRM value
Indoor/Outdoor Reset Controls	9,840	9,840	100%	
Low-Flow Aerators	7,839	6,847	87%	FPH factor- TRM does not direct the use of actual values
Low-Flow Shower Heads	30,760	30,761	100%	
Programmable Thermostats	1,697	1,697	100%	
Total	182,493	174,494	98%	

2.2.2 Impact Findings and Recommendations

The impact analysis identified few issues with project documentation and reported savings. Below is a list of key findings and issues that pertain to the PHA impact analysis:

- **Discrepancies in Documentation:** Minor discrepancies between the project documentation that details energy savings calculations and the reported values provided in the year-end reports were found. While these discrepancies are minor and were quickly resolved when discussed with program staff, this issue highlights the need for additional attention to year-end savings calculations to ensure they align with reported values.

  For one project in particular, refrigerator recycling savings were significantly greater than ex post savings. This difference was due to the fact that no information about the recycled units was included in the project documentation even though savings for recycling were claimed.

- **Methodologies were Consistent:** Methodologies used to calculate ex ante savings were generally consistent with the Illinois Statewide TRM specifications. The most common difference between ex ante and ex post savings was due to the use of site-specific data where the TRM does not direct the use of site-specific inputs.

  Examples of measures where this occurred are high efficiency gas water heaters, low-flow aerators, CFLs, and LEDs.

- **Dual-Fuel Measures are not Fully Funded:** Natural gas savings were claimed for measures that resulted in electric and natural gas energy savings but were only funded by electric dollars. It is suggested that program staff examine co-funding these dual fuel-type measures with electric and natural gas grants in the future to maximize claimable savings or seek clarification from the Illinois Stakeholder Advisory Group on whether or not such savings are claimable.

3. Process Evaluation

This chapter presents the results of the process evaluation for the DCEO Efficient Living Public Housing Authority Program EPY6/GPY3. The process evaluation focused on program changes that have occurred or are planned for EPY7/GPY4, as well as program strengths and challenges. The scope of the process evaluation in the evaluated program year is narrower than in previous years. The process evaluation includes feedback from program staff regarding the program operations and outcomes.

Chapter 3 begins with a discussion of the overall progress of the program, followed by a summary of key findings that were developed from DCEO program managers and with the DCEO's implementation partner, the School of Architecture-Building Research Council located at the University of Illinois at Urbana-Champaign (UIUC).

3.1 Evaluation Objectives

The purpose of the process evaluation is to examine program operations and results, and to identify potential program improvements that may increase program efficiency or effectiveness in terms of levels of participation and program satisfaction.

Key research questions addressed by the process evaluation of EPY6/GPY3 activity include:

- What were the primary changes that occurred during EPY6/GPY3?
- Are there any planned changes coming up for EPY7/GPY4?
- What were the program's greatest successes and challenges during the program year?

3.2 Summary of Primary Data Collection

The primary data collection activities completed for the program evaluation effort were as follows:

- **Program Staff Interviews: P**rogram staff was interviewed about program operations. Program staff responded to questions about program procedures and policies, their perception of motivation to participate in the program, and the processes for tracking program activity.
- **Review of Program Documentation**: ADM staff reviewed documentation of program activities including reports, tracking data, savings calculations, the program website and informational.

3.3 Public Housing Authority Efficient Living Program

The Public Housing Authority Efficient Living Program (Efficient Living Program) is operated in partnership with the School of Architecture-Building Research Council located at the University of Illinois at Urbana-Champaign (UIUC). The program provides grants to Illinois Public Housing Authorities to make energy efficiency improvements to public housing buildings. The program includes retrofit, new construction, and gut / rehab projects.

3.3.1 Participant and Measure Eligibility Requirements

Program eligibility requirements have not changed since the previous evaluation report was published. The program is available to Illinois PHAs that house residents at 30%, 50% or 80% of the average median income. Income requirements are based on the median income in the counties where the properties are located.

The program covers a wide variety of energy saving measures including efficient appliances, lighting, and HVAC equipment. Grant funds may not be used for fuel switching, personnel expenses, purchase of property, operating expenses, projects that repair existing equipment or to replace existing equipment with the same equipment, used equipment, or custom projects with simple paybacks greater than the equipment life.

3.3.2 Program Incentives

Grant awards include standard and custom components described below:

- Standard incentives, which are payments for the installation or use of energy efficient lighting equipment, HVAC equipment, water heaters, motors and variable frequency drives, appliances, insulation, and duct sealing;
- Custom incentives, which are payments for qualifying energy measures at a rate of $0.20 per projected therm or $3.00 per projected therm saved during the first program year of operation.
- Grants are capped at $450,000 in Northern Chicago's Com Ed territory and remain at $350,000 for projects in the Ameren Electric service territory.
- Grants cannot exceed 100% of the total project cost.

3.4 Public Housing Authority Efficient Living Program Grant Recipient Expected Savings

During EPY6/GPY3, thirty-two public housing authorities applied for incentives and twenty-eight received grant funds through the Efficient Living Program. In total forty-six sub grants were awarded including twenty-eight electric grants and eighteen natural gas grants.

As shown in Table 3-1, a variety of building types received energy efficiency measures during EPY6/GPY3. The majority of sites were multifamily housing.

Table 3-1 Building Types Receiving Energy Efficiency Measures

Building Type	*Number of Sites*	*Total Units*
High-Rise (7+ Floors)	46	6,834
Mid-Rise (4-6 Floors)	9	688
Low-Rise (2-3 Floors)	8	300
Row Homes, Garden Apts.	37	1,877
Duplexes	106	212
3-Plexes & 4-Plexes	64	251
Offices, Community Centers., Warehouses	13	-
Scatter Sites (Single Family)	659	659
Total	942	10,821

Source: Efficient Living: Illinois Public Housing Authority Energy: Program Year Six Final Reports

Table 3-2 displays the age of the housing stock that received efficiency upgrades through the Efficient Living Program. The buildings that received upgrades were generally older. The majority of residences were older than 30 years.

Table 3-2 Housing Age for Buildings Receiving Energy Efficiency Measures

Housing Age (Years)	*Number of Sites*	*Total Units*
0 – 20	28	33
21 – 30	18	282
31 – 40	84	2,869
41 +	812	7,637
Total	942	10,821

Source: Efficient Living: Illinois Public Housing Authority Energy: Program Year Six Final Reports

Table 3-3 presents the expected kWh and therm savings for projects completed by each of the PHAs that participated in the Efficient Living Program during EPY6/GPY3.

Table 3-3 Ex Ante kWh and Therm Savings by Participating Public Housing Authority

Public Housing Authority	*Ex Ante kWh Savings*	*Ex Ante Therm Savings*
Aurora	70,739	-
Bloomington	254,317	-
CHA	82,598	3,220
City of Marion	32,542	-
Cook	140,479	61,215
Danville	99,647	984
Decatur	9,444	-
DeKalb	87,820	963
Dupage	-	3,756
Franklin	79,130	-
Freeport	31,314	1,413
Fulton	23,315	4,662
Grundy County	61,345	-
Johnson County	57,037	-
Kankakee	3,410	-
Lake	153,092	-
Lee	96,350	2,509
Logan	45,724	18,260
Menard	55,664	31
North Chicago	23,085	1,123
Pekin	22,606	-
Rockford	863,771	46,076
St. Clair County	111,202	9,244
Whiteside	-	10,423
Winnebago	29,256	17,526
Woodford	48,181	1,087
Total	2,482,068	182,493

3.5 Program Operations Perspective

Interviews were conducted with the Efficient Living Program Manager and DCEO program staff. The interviews focused on program changes that occurred during EPY6/GPY3 and upcoming changes that are planned for EPY7/GPY4. Interviewees were also asked to comment on the successes and challenges that arose during the program year. Each interview was approximately sixty minutes in length and was conducted either over the phone and in-person.

3.5.1 Program Staffing

Staffing did not change during the third year of PHA program activity. The primary project manager manages the day to day operations of the program. She fulfills an oversight role,

assists with the coordination of participating PHAs, and is responsible for fiscal tracking and the disbursement of grant funds. The project coordinator has been with the program for the past three years. The project coordinator fulfills an administrative role and works closely with PHAs to meet reporting requirements and coordinate technical staff for on-site visits. There is also one staff member who spends approximately 50% of his time providing technical assistance to support project tracking and energy savings calculations. Two new interns were hired this year and will be responsible for maintaining project level documentation and performing verification site visits. Generally interns will attend the visit with a senior staff member and is required to complete a verification report for each site. Interviewee feedback suggests that current staff resources are adequate and meet the operational needs of the Efficient Living Program.

DCEO lost two key staff members responsible for Low Income Program oversight and administration. Additional details about the impacts of this change can be found is below in Section 3.5.6 Program Challenges.

3.5.2 Outreach Events

Efficient Living Program staff hosted 14 events during EPY6/GPY3. These events were targeted at PHA administrators, city officials, and trade allies. The purpose of these events was to provide education about energy efficiency, and increase awareness of the Efficient Living Program. Table 3-4 below provides a list of the events.

Table 3-4 EPY6/GPY3 Outreach Events

Date	*Location*	*Outreach/ Training Title*
7/11/2013	Rockford, IL	Energy Performance Contracting
9/20/2013	Bloomington, IL	Illinois Association of Housing Authorities (IAHA) ED Annual Meeting
10/15/2013	Springfield, IL	HUD Rental Assistance Demonstration (RAD) Program.
10/29/2013	Rosemont, IL	Connecting Trade Ally Partners with Public Sector Clients to Produce Cost Effective EE Investments
10/31/2013	Madison, WI	Meeting with Bakery Tilly RAD Consultants
11/5/2013	East Peoria, IL	DCEO Trade Ally Show
11/8/2013	Glenda, IL	Northern IL Chapter of Housing Authorities Quarterly Meeting
11/14/2013	Springfield, IL	Illinois Chapter of NAHRO 2013 Annual Meeting
11/25/2013	Elgin, IL	Met with PHA to discuss RAD Demonstration Project.
3/14/2014	Springfield, IL	Central PHA Chapter of CICHO Meeting: Benchmarking, What is it?
3/27/2014	Chicago, IL	PHA Round Table Discussion
3/27/2014	Chicago, IL	25th Anniversary Celebration of the IL Energy Efficiency Affordable Housing Construction Program
4/24-25/2014	Decatur, IL	IAHA Maintenance Management Clinic
5/13/2014	Chicago, IL	DCEO PHA Roundtable Event: Methods Technologies and Incentives to Improve EE

3.5.3 EPY6/GPY3 Program Changes

Program staff indicated that several program changes took place during EPY6/GPY3. Incentives were offered for the replacement of mercury thermostats with programmable thermostats. The incentive is $70 per replacement. Consistent with the other prescriptive incentives offered through the program, this amount is intended to cover the full cost of the measure. Indoor/outdoor LED or induction wall packs are now eligible for standard incentives. In previous program years replacing an incandescent lamp with an LED lamp was a custom measure, however due to increased installations of LED lamps, replacement of incandescent lamps with LEDs is now a standard measure.

In additional to the enhanced list of eligible measures, the custom incentive rate per therm saved has increased from $2.00/therm to $3.00/therm. According to staff, most changes to incentive levels or measures offered are in response to DCEO's public sector program changes. To further encourage implementation of natural gas saving measures, DCEO increased the incentive for custom natural gas measures to $3.00/therm for the EPY6/GPY3 program year. This custom incentive rate will remain through EPY7/GPY4 as well. In

previous years the maximum incentive amount that could be awarded to any one PHA was $350K. In EPY6/GPY3 the maximum incentive amount was increased to $450K; this change mainly impacted PHAs in the ComEd Territory. Staff indicated that there are more grant dollars available, and projects tend to be larger in the ComEd territory.

The Efficient Living Program has implemented a new website to provide information to Illinois PHAs that have participated in the past, or are interested in participating in the future. The website is hosted by University of Illinois Urbana-Champaign. The URL is http://www.ilpha.org/. The Homepage is pictured below in Figure 3-1.

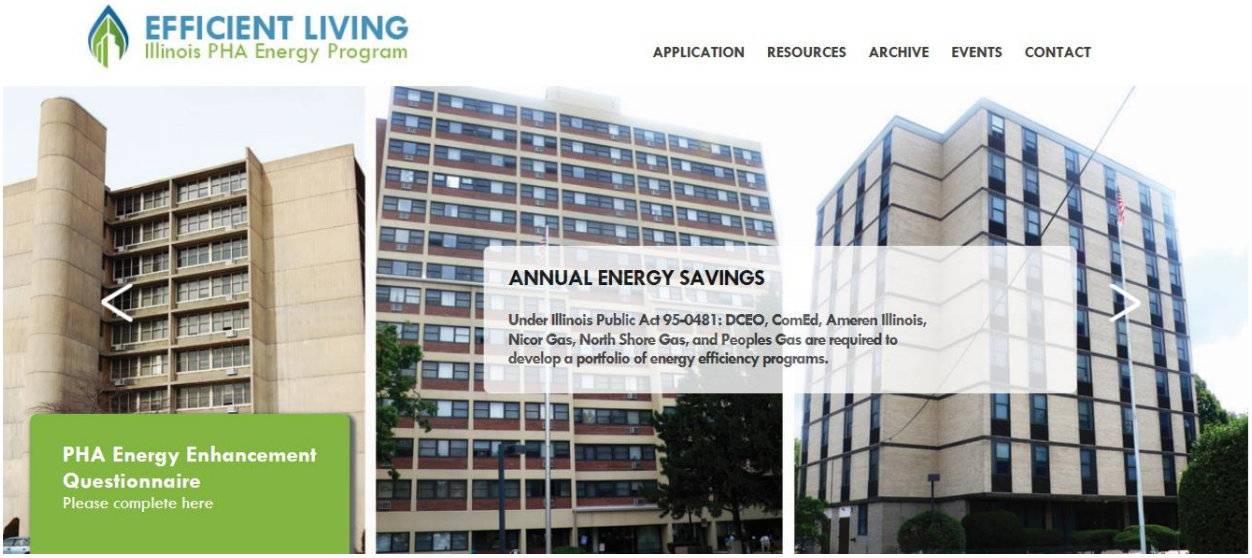

Figure 3-1Efficient Living Program Homepage

The new website enables PHA staff to request an energy assessment by completing a digital form, submitting a program application, and find out more about partner programs offerings. Visitors can download applications or directly access program website for the HUD Rental Assistance Demonstration (RAD) Program, as well as DCEO's Affordable Housing Construction Program. Figure 3-2 below provides a screen shot of the Application Page. Program staff indicated that these programs target a similar market and staff often field questions related to both programs. In addition to application material a website visitor can also access other authorization and/or certification forms that are required for participation.

Figure 3-2 Efficient Living Program Application Page

Program staff have not received much feedback regarding the new website, but indicated that having this central location for outreach, program material, and case studies has been valuable to them. The web statistics indicated that the site received approximately 1,800 hits over the last twelve months.

3.5.4 Changes Planned for EPY7/GPY4

Program staff also indicated that several changes are being discussed for the upcoming program year, the first of which is to allow grants to span over multiple years. Previous research indicates that the timing of grant funds has created challenges for PHAs with regard

to planning project work with contractors and completing installations on time. Thus far, if projects are not complete by the end of the program year, the PHA is required to report what is complete, and reapply the following year. Staff noted that if the suggested change is implemented there would be greater flexibility with work schedules, which could ultimately improve the continuity of program delivery.

Staff noted that The Building Research Council – School of Architecture, the organization responsible for the implementation of the Efficient Living Program, is planning a research project designed to improve understanding of the impact of smart meters on residential energy usage and their potential to bring energy efficiency awareness to residents and real time energy use data which could inform program design considerations. To fund the research, The Building Research Council applied for a grant offered by the Illinois Science and Energy Innovation Foundation. The grant funds would be used to purchase and install equipment and to collect data that will inform baseline operating conditions and energy saving potential.

Technologies that are under consideration are the Energy Joule, designed by Ambient Devices, which displays real-time energy prices and home consumption levels.[1] The screen illuminates to notify a home owner when energy resources are strained and prices are increasing. Also under consideration are voice controlled thermostats and Nest thermostats. Technologies for window AC units are also being considered; ThinkEco is an example. According to program staff, many of the PHA residential units are equipped with window AC units for cooling purposes. SmartAC is a product that plugs into a window AC unit to provide features such as wireless control, temperature monitoring, and a customizable schedule.[2] Figure 3-3 below provides a picture of the Energy Joule on the left and the Smart AC adapter on the right. Staff indicated that if energy savings are realized from the use of these grid technologies, in the future, they very likely become part of the list of eligible program measures.

[1] http://ambientdevices.myshopify.com/products/energy-joule

[2] http://www.thinkecoinc.com/products/smart-ac/

Figure 3-3 Smart Grid Technologies – Energy Joule and SmartAC Adapter

In EPY7/GPY4, the Efficient Living Program is plans to pursue activities that would strengthen its partnership with the DCEO Trade Ally Network. Staff indicated that contractors could benefit from more formal communication and education about the Efficient Living Program and the nuances of working with PHAs. Timing of funds continues to be an issue for contractors. Most PHAs have to wait for grant funds to be released before they are able to pay contractors, which can be challenging for both PHA staff. For projects that exceed a budgetary benchmark there are certain procurement rules that PHAs have to follow and that contractors need to understand prior to beginning work. Staff indicated that the DCEO Trade Ally Network could be a valuable delivery mechanism for an Efficient Living Program training module that could address these challenges.

Also new in EPY7/GPY4 is the addition of a "Plaque Program", which was developed in collaboration with the staff at The Midwest Energy Efficiency Alliance (MEEA.) Program staff noted that the program was designed to acknowledge PHAs that achieve 15%-20% energy savings from projects implemented with Efficient Living Program funds. If the project achieves the minimum energy savings threshold the PHA receives a plaque, as shown in Figure 3-4 below. The plaque is designed to highlight success and encourage energy savings within the PHA community. Staff indicated that the plaques have been and will increasing be presented to recipient PHAs at regional events as a way honor their efforts and generate interest among those that have participated in the past and still have projects pending, or among PHAs that have just begun to explore the program and benefits of energy efficiency. In the long run the plaque program could be used as a branding strategy for the program and highlighted as an achievement in the PHA community.

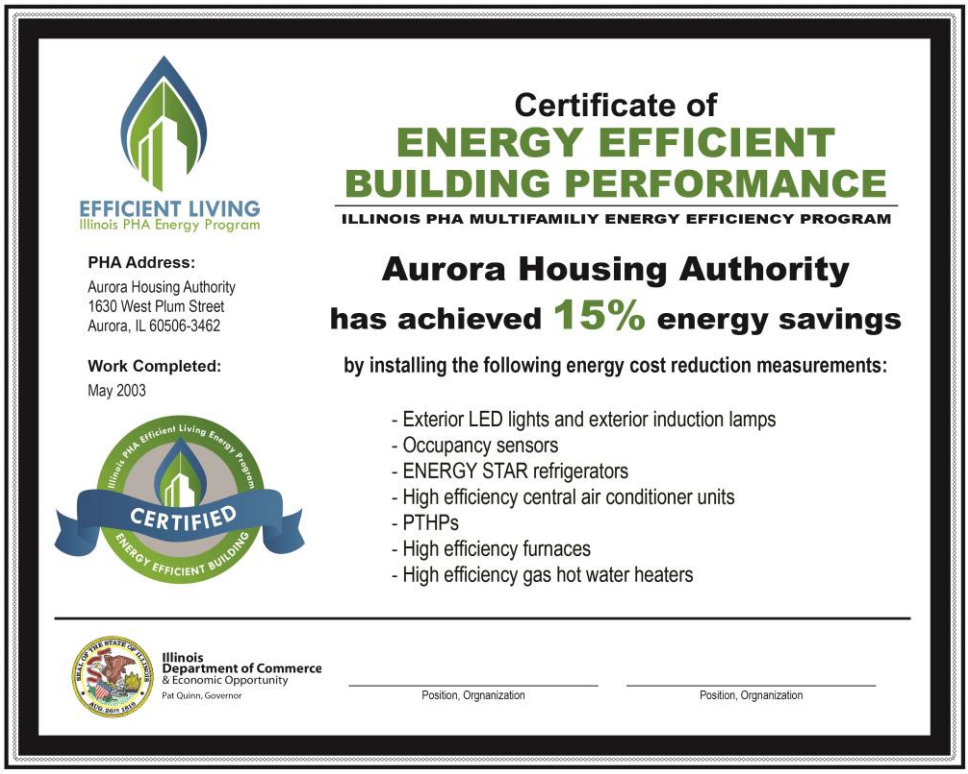

Figure 3-4 Plaque for PHAs

3.5.5 Program Successes

Staff were asked to comment on what they believe are the program's greatest successes. Most notable were the administrative efficiencies that have evolved since the program's inception in 2010. Staff indicated that the operational processes required to manage, deliver, and track the program activity are fluid and working well. The consistency in personal contributes to the overall continuity of the program delivery, as well as support from the intern staff members and the Energy Resources Center in Chicago, who have helped with site visits and technical support.

The PHAs are also learning from their experience with the program. The entire scope of most PHA projects cannot be completed in one program cycle. Staff indicated that the program has encouraged PHAs to plan ahead, prioritize building maintenance, and consider implementing energy efficiency projects through the PHA program as a low cost strategy to reduce energy consumption and improve the lives of residents.

During EPY6/GPY3 several PHAs partnered with Energy Service Companies (ESCOs) to fund large energy efficiency upgrades. PHAs partnering with ESCOs will leverage program funds and ESCO funds to complete projects that they otherwise would not have been able to. Staff indicated that the partnership was mutually beneficial and more PHAs are looking towards an ESCO partnership to fund additional upgrades in the future.

3.5.6 Program Challenges

Staff was asked to comment on challenges of the program. Most notable was the recent loss of two key DCEO staff members. The implementation partner, Building Resource Council-School of Architecture, indicated that these two staff members were the primary points of contact between DCEO and the implementation partner. In the interim, two staff members have been transferred from the Recycling Department to support the coordination and administration of the PHA program. It will take time for DCEO to train new staff on the operational processes used to support the administration of all three Low Income Programs, and for the communication to be fluid once again.

Program staff commented on feedback that they receive from PHA staff, which does not necessarily reflect program challenges, but rather trends in participant satisfaction issues. Program staff has received consistent feedback from PHA staff members on the prevailing wage requirements and the timing of the grant funds. Some PHA staff has indicated that the prevailing wage requirement exceeds what contractors typically pay their crews in labor wages. They have indicated that if the wage requirements were followed industry standards, the grant dollars could be used to implement more energy savings measures. Grant funds typically become available between late February and late March. According to program staff, PHA staff has to continually field complaints from contractors who are anxious to get paid or do not understand the grant process and compressed work schedules. One solution to this is a stronger partnership with the Trade Ally Program so contractors receive education on the program operations and funding contingencies.

Program staff also indicated that additional funds can always be utilized, specifically in the Ameren Illinois territory. These have consistently been the first funds to run out, and where the greatest needs exist. Gas measures are in high demand in all utility service territories. Program staff indicated that there are many boilers that need to be commissioned or replaced. If additional program gas funds were available, program staff believes that they could be utilized for major boiler projects.

3.5.7 Summary of Interview Findings

Key trends and issues addressed by respondents include:

- **Staffing Changes:** The implementation partner staff, Building Research Council – School of Architecture, have remained consistent throughout the current program year, EPY6/GPY3. However, DCEO lost two key staff members responsible for program oversight and administration. Overall the staffing resources appear to be adequate for effective program delivery. As DCEO staff train new personnel on the program operations and oversight functions, communication and coordination between the Building Research Council – School of Architecture and DCEO should improve.
- **Outreach Events:** The Efficient Living Program staff conducted fourteen outreach events during EPY6/GPY3. Outreach events are designed to target the Illinois PHA community, contractors, and city officials that are interested in learning more about grant

dollars available for energy efficiency investments. The events provide education about energy savings opportunities and information on how to apply and qualify for DCEO funds.

- **Incentive Changes:** Several incentive changes occurred during EPY6/GPY3. Rebates are now available for the replacement of mercury thermostats with programmable thermostats. Additionally, LED lighting upgrades are available as a standard measure offering. Also, the custom incentive level has increased from $2.00/therm to $3.00/therm for gas savings measures. The overall incentive cap for projects in the ComEd service territory was also increased from $350K to $450K. All program changes made in EPY6/GPY3 are appropriate and in-line with changes that are being made to the Public Sector, Illinois Energy Now Programs.
- **New Program Website:** A new program website was developed to provide information to Illinois PHAs who have participated in the past, or are interested in participating in the future. The new website enables PHA staff to request an energy assessment by completing a digital form, submit a program application, and find out more about partner programs offerings. Visitors can download applications or directly access program website for the HUD Rental Assistance Demonstration (RAD) Program, as well as DCEO's Affordable Housing Construction Program. Overall, the program website is well organized, and serves as central location for the necessary program forms for not only participation but also other ancillary documentation, such as appliance recycling guidelines and certifications, income qualifications forms, and authorization forms to release utility billing data.
- **Planned Changes for Program Year EPY7/GPY4:** Several changes are planned for EPY7/GPY4. There is discussion regarding extending the grant cycle beyond one year, June 1st through May 31st. Research indicates that the timing of the program year has limited the scope projects in the past and continues to be a point of contention between PHAs and their contractors. Allowing projects to span multiple program years will improve the continuity of program delivery.
- **Research on Breakthrough Technologies:** Breakthrough technologies such as smart meters, appliance adapters, and real-time energy dashboards are being researched by the implementer, The Building Research Council – School of Architecture. The research efforts are aimed at developing an energy use baseline from future energy savings could be measured. If potential exits with these grid technologies they could be included as future program offerings.
- **New Education and Research Strategies:** Also two new education and outreach strategies are being developed for EPY7/GPY4. The Efficient Living Program is looking to strengthen its partnership with the DCEO Trade Ally Program. Staff interviews indicate contractors could benefit from being better informed about working with the program and PHAs. Some are not as familiar with the PHA procurement process, while

others have little experience working with the non-profit sector and the nuances of grant funding. Inviting these PHA contractors to join the DCEO Trade Ally Network is an approach that will be used to improve communication and educate contractors about DCEO Programs and processes. To champion the success of PHAs that are achieving at least 15% energy savings, The Efficient Living Program started a Plaque Program. Each PHA with projects that meet the minimum efficiency requirements will be presented with a certificate of success that is mounted on a plaque. In the long run it could be used as a branding strategy for the program and highlighted as an achievement in the PHA community.

- **Program Successes:** Program successes include a smooth and streamlined delivery structure. The operational processes required to manage, deliver, and track the program activity are fluid and working well, from an implementation perspective. The PHAs are also learning from experience and are more aware and proactive about identifying and implementing energy efficiency projects. Also, during EPY6/GPY3 several PHAs partnered with Energy Service Companies (ESCO's) to fund large energy efficiency upgrades.
- **Program Challenges:** The loss of two key DCEO staff members who provided oversight and administrative support to the implementer. Some PHA staff has indicated that the prevailing wage requirement exceeds what contractors typically pay their crews in labor wages. Contractors have said that if the wage requirements were more in line with industry standards the grant dollars could be used to implement more energy savings measures. Additionally, the timing of program funds continues to present challenges to PHA needing to complete project work by the end of the program year, May 31st. Finally, program staff also indicated that additional funds can always be utilized, specifically in the Ameren Illinois territory, as well as additional dollars for gas measures could be utilized to replace outdated boilers.